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Defining the need for blood and blood products transfusion following suicide bombing attacks on a civilian population: A level I single-centre experience

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ABSTRACT

Introduction: Knowledge of patterns of blood use in the care of mass casualty settings is important for preparedness of medical centre resources and for maximising survival when blood supplies are limited. Our objectives were to review of our experience with the use of blood products and define the utilisation of blood transfusion following suicide bombing attacks.

Patients and methods: We conducted a retrospective analysis of blood and blood product transfusion following civilian bombing attacks at a level I trauma centre in Jerusalem, Israel from 2000 to 2005. The study group consisted of 137 patients who were admitted following 17 suicide bombing attacks which were carried out in Jerusalem during the 5-year period. Demographic data, number of units of blood and blood products transfused and the need for massive transfusions were recorded and analyzed.

Results: Fifty-three patients received blood transfusions (38.7%). There were 33 males (62.2%) with a median ISS of 13 (range 4–25). These 53 patients received 524 PRBC, 42 WB, and 449 FFP. The mean number of PRBC transfused/admitted patient was 3.82 units (range 0–59). Thirty patients (21.9%) received 236 PRBC (45% of total PRBC) at the first 2 h. The ratio of ordered to transfused blood was 946:524. The FFP:PRBC ratio for all transfused patients was 1:1.17. The number of PRBC transfused per attack correlated with the number of patients admitted per attack. The most commonly transfused blood type was A (52.3%). Only 18 units of uncrossed-matched blood were transfused (3.3% of total). 14 patients (10.2%) received massive transfusions. These patients received 399 PRBC (76.1% of total units transfused) and the average number of PRBC transfused was 28.5/patient (10–59).

Conclusions: More than 1/3 of casualties admitted following civilian bombing attacks received transfusions, most in the first 2 h. Large-scale attacks will require more blood and blood products than small-scale attacks. Twice the number of PRBC ordered than transfused reflects a known trend for over-triage during the initial assessment following bombing attacks. One tenth of patients received massive transfusion.

Introduction

Massive bleeding is a major cause of death in civilian and military casualties. In the United States 10–15 percent of all RBC units are used to treat injured patients.[1] Massive transfusion, defined as transfusion of 10 or more units of packed red blood cells (PRBC) over the initial 24 h, has been the focus of much recent research.[2,3] Trauma centres have integrated massive transfusion protocols that include activation of additional personnel, employment of rapid infusion systems, automatic thawing of plasma and changes in cross matching policy. Recent analysis of combat events from Iraq and Afghanistan demonstrates that approximately 20% of casualties will require blood transfusion and 7% will require massive transfusions.[4,5]

Few articles have been written, however, directly addressing the management and resource utilisation, specifically blood requirement, following mass casualty incidents (MCI). The term PPI, or PRBC transfused per admitted patient, was introduced by Soffer at al. in order to estimate the number of PRBC required based on the initial number of patients admitted from the emergency department (ED).[6] Soffer et al. analyzed 18 consecutive terrorist attacks and found that the number of PRBC units transfused per patient was related to incident size, with smaller incidents

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(<25 evacuated casualties) having a number of PRBC transfused to patient per incident (PPI) of 0.7 and larger incidents having a PPI of 1.5. Half of the units of PRBC's were transfused in the first 2 h after the incident and a similar number was type O blood.[6]

The workload on blood banks (BB) during MCI can be overwhelming. Knowledge of the patterns of blood use in the care of mass casualty settings is also important for medical centre resource planning, for designing protocols to test the efficacy of blood transfusion policy, and for maximising survival when blood supplies are limited. For all of these reasons, we undertook to review our experience in blood products utilisation during the 2000–2005 terrorist bombing attacks on the civilian population in Jerusalem. Our primary goal was to define blood and blood product usage following these incidents. Our secondary goals were to evaluate massive transfusions and the timing of blood and blood products transfusion.

Materials and methods

Data collection

We retrospectively analyzed the data of all victims of suicide bombing attacks (SBA) who were admitted to the level I trauma unit of the Hadassah University Hospital, Jerusalem, Israel from October 2000 to December 2005. Data was prospectively collected by the trauma registry. The records of all patients admitted with the diagnosis of trauma secondary to terrorist attacks were reviewed and scanned for demographic data, injury characteristics, invasive procedures and outcome.

The amount of blood and blood products transfused to the study population was obtained by reviewing the Hadassah University Hospital BB database. Data was retrieved regarding blood and blood products, and time of release from the BB. The database was scanned for type and cross-matching, PRBC preparation and release. The number of unused blood products which were returned to the BB was also recorded. The number of PRBC's units transfused was calculated by subtracting the number of retuned units from the number of released units. Based on previous reports and clinical relevance, we divided the time periods into the initial 2 h, 2–6 h, 6–24 h and over 24 h.

Israel National Blood Program

In Israel, the Emergency Medical System (EMS) and the National Blood Program are operated by Magen David Adom (MDA), the national equivalent of the Red Cross. MDA blood services were established as the sole provider of blood and blood components in Israel. Demand for blood during wars and ongoing terrorist attacks on civilians have challenged its ability. Nationwide, 90% of the whole blood units are collected in daily mobile drives. An additional 10% are collected in fixed donation sites at MDA first aid stations and BB hospitals. Civilians donate 75% of the total blood products supply, the remaining donations given by enlisted personnel.[7]

Hadassah blood bank protocol during an MCI

The Hadassah BB protocol and contingency plans were created for the management of blood requirements following MCI. The protocol defines certain activation steps which are necessary to ensure adequate blood supply to the emergency department (ED), trauma unit, operating room and intensive care units. Information regarding an MCI can reach BB personnel either directly from hospital administration, central MDA command, or as has happened on several occasions, through the media or Internet.

Once the BB has been alerted, it is the responsibility of the BB representative to evaluate the magnitude of the event, i.e. the number of wounded, attack setting and expected time to arrival. Small to medium sized events are defined when up to 50 patients are expected in the ED. A terrorist attack generating more than 50 patients would be considered a large-scale event. The BB representative takes several steps including notification of BB supervisor on-call and BB director, recruitment of additional personnel, preparation of additional sites in the BB for handling of blood samples, verification of BB inventory, and recruitment of additional units of blood from MDA. According to our protocol three units of blood are expected for a severely injured patient and 2 units for a moderately injured patient. Blood handling is switched from automated to manual methods. Initial ABO and D blood typing is carried out by forward test, followed by complete typing test. Segments from PRBC are prepared for cross-match for 10 units of type A and O, and 14 units of fresh frozen plasma (FFP) are thawed (10 AB, 2 A and 2 B). According to demand, 2 units of non cross-matched type O− are delivered to the trauma unit, ICU or operating room. A BB representative and a Transfusion Medicine physician are stationed in the ED and trauma unit to coordinate blood transfusion, detect mislabelling and ensure proper handling of blood samples. Recipients whose ABO group has been determined, but compatibility testing has not been completed, will receive ABO-compatible PRBC. Compatibility testing is then completed as soon as possible.

Many patients, especially those in critical condition, will require blood before final identification. To prevent mishandling of blood samples, each patient is temporarily assigned an identification number and another separate random number. Identification number is corrected as soon as the patient is confidently identified. The random number is kept and stored to ensure continuity of records.

Transfusion definitions

One unit of PRBC was defined as a 250-mL bag. Similarly one unit of FFP was defined as a 300-mL bag. Platelet administration took place in 6-pack increments where one 6-pack equalled to a 200–300 mL bag. Massive transfusion was defined when a patient received 10 or more units of PRBC within the initial 24 h.

Calculation of blood typed, prepared and transfused and limitations

For the purpose of oxygen transfer PRBC were preferred. Only when whole blood (WB) was available and according to BB considerations, mainly availability, WB was transfused in addition to PRBC. WB was released during MCI, when fractionation process was delayed and shortage of blood was expected.

Whenever possible, type and cross-matched blood was transfused. Blood released from the bank as uncrossed-matched was transferred to the trauma unit on demand from the trauma unit but without patient identification. Thus, it was impossible to assess the exact number of patients who received uncrossed-matched O− blood. Transfusions received within 30 min of arrival in the ED were non cross-matched (i.e. emergency release), while those received after 30 min were ABO/Rh cross-matched units. Since the data in this manuscript is based on individual patient characteristics, and only 18 units of O− PRBC were transfused without cross-matching (3.3% of all PRBC transfused), we decided not to include those units in the analysis of PRBC's and reported O− uncrossed-matched blood separately per attack. All products transfused were stored in the BB and product availability or shelf life was not a limiting factor during the attacks.

Per admitted patient index (PPI) was defined as units of product transfused per casualty.[6] Because of the degree of contamination of